TM 11-5543

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIAC SET AN/PDR-27 (*)

This reprint includes all changes in effect at the time of publication - Changes 1, 4, 5, and 6.

DEPARTMENT OF THE ARMY • AUGUST 1952

Section 3. INSTALLATION

3. Initial Testing

(See fig. 3-3 **or 3-3.1**.)

Test the radiac * * * the following steps:

Note. (Added) When performing steps 5 through 8, use figure 3-3 with Radiac Set AN/PDR-27A and figure 3-3.1 with Radiac Sets AN/PDR-27C, and -27E. Meter readings of steps 5 through 8 for Radiac Set AN/PDR-27A are given in the text; meter readings for the two other models are given in table 3-1.

* * * * * * *

Step 4. Remove the radioactive test sample from the carrying case.

Note. (Added) A dimple is provided on the bottom surface of the radiacmeter housing of Radiac Sets AN/PDR-27C and -27E. When the active end of the radioactive test sample is placed in this dimple, maximum meter deflection is obtained.

* * * * * * *

The legend of figure 3-3 is changed to read:

Figure 3-3. Radiacmeter Test Set-up **for Radiac Set AN/PDR-27A.**

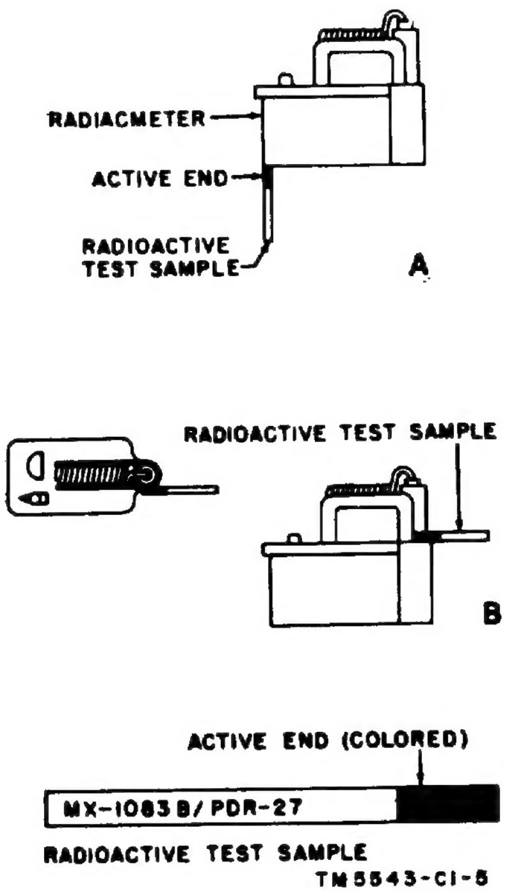


Figure 3-3.1. (Added) *Radiacmeter test set-up for Radiac Sets AN/PDR-27C and -27E.*

Table 3-1. Initial Test Meter Readings for All Models Except Radiac Set AN/PDR-27A (Added)

Step	5	6	7	8
Range switch setting	500	50	5	.5
Meter reading milliroentgen hour	10-30	5-15	1-3	.1-0.3

Section 4. OPERATION

6. Operation Under Unusual Conditions (Added)

The operation of Radiac Set AN/PDR-27(*) may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. Instructions on procedures for minimizing the effect of these unusual operating conditions are given in *a* through *c* below.

a. Operation in Arctic Climates. Subzero temperatures and climatic conditions associated with cold weather adversely affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

(1) Handle the equipment carefully.

(2) Keep the equipment warm and dry. If necessary, construct an insulated box for the set.

(3) Allow at least 1 minute for the tubes to warm up.

(4) When equipment that has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also arises when equipment warms up during the day after exposure during a cold night.

(5) Use any improvised means to protect the dry batteries, because they will fail if not protected against the cold. If necessary, preheat the batteries. Store spare batteries in bags lined with kapok, spun glass, fiber materials, animal skins, or woolen clothing.

b. Operation in Tropical Climates. When operated in tropical climates, this equipment might be used in swampy areas where moisture conditions are more acute than normal. The high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the ambient air. To prevent moisture seeping into the set, make sure that all the mounting screws are tight on the front panel and battery compartment cover.

c. Operation in Desert Climates. Conditions similar to those encountered in tropical climates often prevail in desert areas. The main problem that arises, however, is the large amount of sand or dirt which may enter the equipment. Keep the equipment as clean as possible.

meter housing containing four holes that permit access to the calibration potentiometers.

*   *   *   *   *   *   *

b. Calibration Procedure.

Warning: Calibration of this * * * to the radiation.

Step 1. **In Radiac Sets AN/PDR–27A and –27C, loosen** the six screws securing the radiacmeter panel to the housing. Remove the housing and replace it with the special housing. **In Radiac Set AN/PDR–27E, remove the calibration port cap.** Check the battery * * * of the radiacmeter.

Step 2. Arrange the equipment as indicated in figure 7–5 **according to distance measurements given in table 7–1.1.** Measure and adjust * * * source in inches.

*   *   *   *   *   *   *

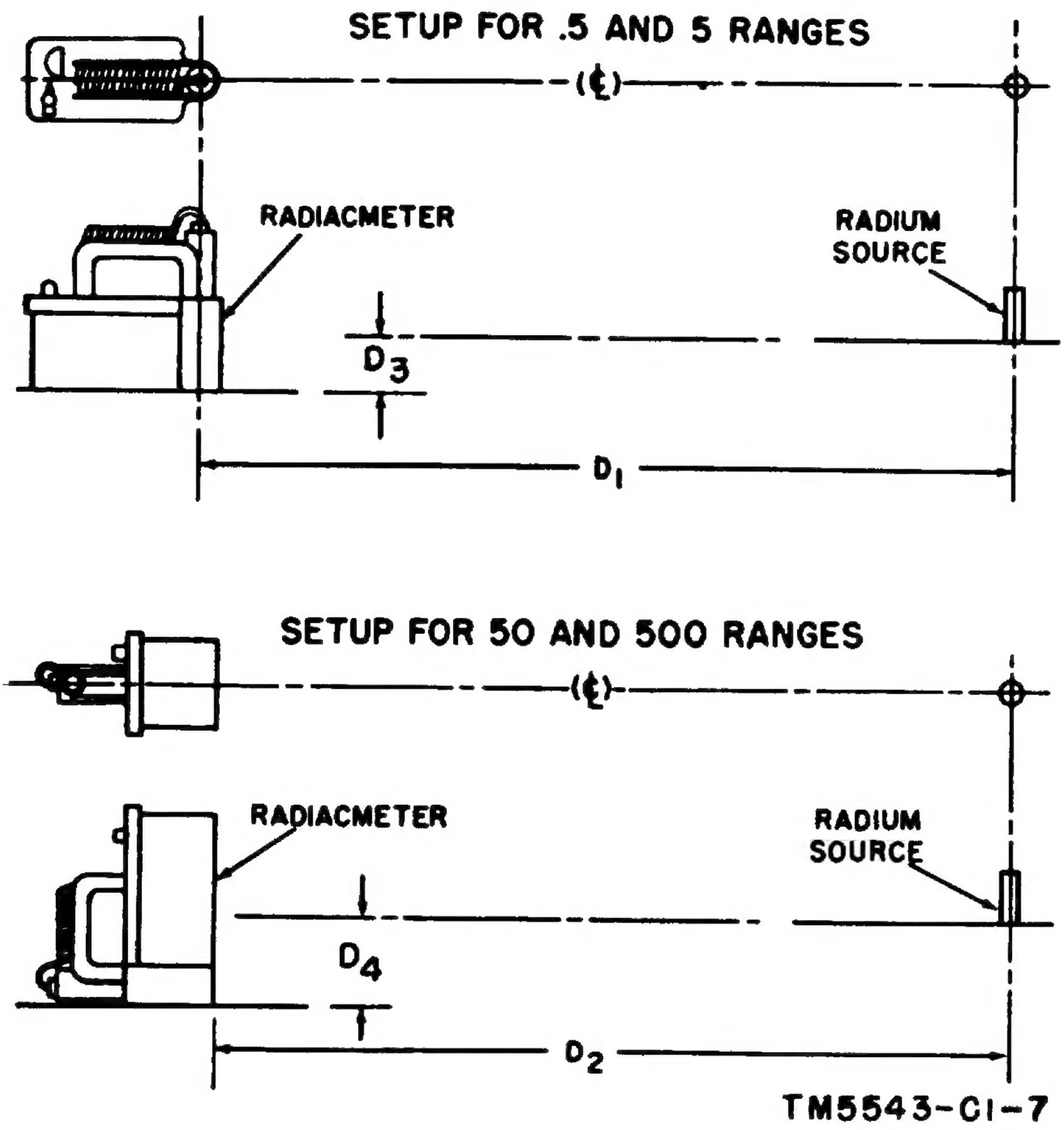


Figure 7–5. (Superseded) *Calibration set-up data.*

Table 7-1.1. Calibration Set-Up Data
(Added)

Check	Range	Adjust	To read mr/hr	Distances in inches for Radiac Set AN/PDR-27(*)					
				-27A		-27C		-27E	
				D1	D2	D1	D2	D1	D2
1	.5	R110	.40	81.6		80.6		80.6	
2	5	R104	4.0	25.8		25.4		25.4	
3	50	R106	40		7.72		8.06		8.06
4	500	R108	400		2.14		2.54		2.54
Distance D3 for all checks.				2¾		2¾		2¾	
Distance D4 for all checks.				10½		10½		11⅜	

Note. Above values apply only to calibration by 2-milligram radium source. Radium source must be set up in line with dimple in steps 3 and 4.

7. Removal and Replacement of Parts
(G. M. tube in probe)

a. Removal of V-102 (fig. 7-6 **or 7-6.1**).

* * * * * * *

Step 6. Unscrew the plug * * * the "0" ring. **In Radiac Set AN/PDR-27E, unscrew the threaded ring (0 209) at the end of the probe, and then remove the cap (0 204) (fig. 7-6.1).**

* * * * * * *

Step 8. With your thumb * * * the probe housing. **In Radiac Set AN/PDR-27E, care should be taken to prevent the mounting cylinder (0 208) from sliding out with V102; otherwise, the lead shield (E201) may become damaged.**

b. Replacement of V-102 (fig. 7-6 **or 7-6.1**).

* * * * * * *

Step 7. Slip the washer * * * of the housing. Using the rounded end of the special wrench, tighten the plug. **In Radiac Set AN/PDR-27E replace the anode cap, and then screw the threaded ring (0 209) into the rear of the housing. Tighten the cap and then tighten the cable packing nut (H201).**

* * * * * * *

Changes in force: C 1, C 4, and C 5

TM 11-5543
*C 5

CHANGE No. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *23 September 1965*

RADIAC SETS AN/PDR-27A, AN/PDR-27C, AND AN/PDR-27E

TM 11-5543, 22 August 1952, is changed as follows:

Note. The parenthetical reference to previous changes (example: page 1 of C 4) indicate that pertinent material was published in that change.

Inside Front Cover (As added by C 3, 8 Feb 1962). Delete the warning symbol and substitute:

WARNING
RADIATION HAZARD

*This change supersedes C 3, 8 February 1962, so much of TM 11-6665-201-12P, 10 October 1960, and TM 11-6665-201-35P, 10 October 1960, as pertains to Radiac Sets AN/PDR-27A and AN/PDR-27E, and replaces Signal Corps Repair Standard No. REP-629, issue No. 1, 11 January 1956.

Radioactive Test Sample MX-1083/PDR-27 contains the equivalent of 5 microcuries of cobalt 60; Radioactive Test Sample MX-1083B/PDR-27 contains 7 micrograms of radium. Be extremely careful while using these test samples, and follow safe procedures for handling, storage, and disposal (AR 700-52, AR 700-380, and TB SIG 225).

Page 1-1. Delete paragraphs 1.1 and 1.2 (page 1 of C 4) and substitute:

1.1. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

1.2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting these improvement recommendations. This form will be completed using pencil, pen, or typewriter and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-MR-(NMP)-MA, Fort Monmouth, N.J., 07703.

Page 1-10, table 1-4 (As changed by C 3, 8 Feb 1962), "Radiac Set AN/PDR-27C" column, line 7. Delete "Turned on by tilting radiacmeter or by using panel push button" and substitute: Turned on by tilting radiacmeter or by pressing push button H116 (fig. 1-7).

Page 6-0, paragraph 8 (page 11 of C 4), line 4. Delete "TM 9-2851 (Painting Instructions for Field Use)" and substitute: TB SIG 364.

Page 7-8, paragraph 6, caution (As added by C 3, 8 Feb 1962). Delete the caution notice and substitute:

***Caution:* Do not force any calibration adjustment (R104, R106, R108, or R110) beyond its limit stops; the contact arms may be broken.**

Add the glossary (as added by C 3, 8 Feb 1962):

GLOSSARY

Alpha particle—A particle emitted spontaneously from the nuclei of some radioactive elements. It has a mass of four units and an electrical charge of two positive units.

Beta particle—A charged particle of very small mass emitted spontaneously from the nuclei of some radioactive elements. Physically, the beta particle is identical with an electron moving at high velocity.

Curi—A unit of radioactivity; it is the quantity of any radioactive material in which 3.700×10^{10} nuclear disintegrations occur each second.

Gamma ray—An electromagnetic radiation of high energy originating in atomic nuclei and accompanying many nuclear reactions. Except for the method of production, gamma rays are identical physically with high energy X-rays.

Intensity—The energy (of any radiation) incident upon (or flowing through) a unit area, perpendicular to the radiation beam, in unit time. In relation to nuclear radiation, the term, intensity, is sometimes used to express the exposure dose rate in roentgens or milliroentgens per hour.

Isotopes—Multiple forms of an element, which have identical chemical properties but different atomic masses and nuclear properties.

Millicuri—One-thousandth of a curi. (*See* curi.)

Microcuri—One-millionth of a curi. (*See* curi.)

Milliroentgen—One-thousandth of a roentgen. (*See* roentgen.)

Radioactivity—The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nuclei of unstable isotopes.

Roentgen—A unit of exposure dose of gamma radiation. One roentgen is the amount of radiation that produces, in one cubic centimeter of dry air, ionization equal to one electrostatic unit of charge (negative or positive).

Shielding—Any material or obstruction that absorbs radiation and thus tends to protect personnel (or materials) from the effects of radiation.

Changes in force: C 1, C 4, C 5, and C 6

TM 11-5543
C 6

CHANGE No. 6

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *16 April 1968*

RADIAC SETS AN/PDR-27A, AN/PDR-27C, AND AN/PDR-27E INCLUDING REPAIR PARTS AND SPECIAL TOOL LISTS

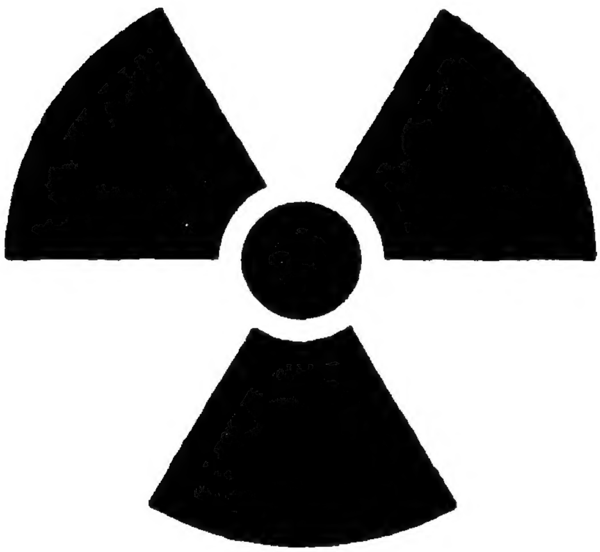
TM 11-5543, August 1952, is changed as follows:

The title is changed as shown above.

Note. The parenthetical reference to previous changes *(example:* page 4 of C 5) indicates that pertinent material was published in that change.

Inside front cover (page 1 of C 5, 23 Sep 65). Delete the warning notice and substitute:

WARNING!
RADIATION HAZARD



STD-RW-2

Co 60 or RA 226

Radioactive Test Sample MX-1083/PDR-27 contains the equivalent of 5 microcuries of cobalt 60; Radioactive Test Sample MX-1083B/PDR-27 contains 7 micrograms of radium. Be extremely careful while using these test samples, and follow safe procedures for handling, storage, and disposal (AR 700-52, AR 755-15, TB 3-6665-200-12, and TB 3-6665-201-12).

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-5543

RADIAC

SET

AN/PDR-27

DEPARTMENT OF THE ARMY • AUGUST 1952

United States Government Printing Office

Washington : 1952

SECTION 2
THEORY OF OPERATION

1. RADIOACTIVITY AND ITS DETECTION.

a. INTRODUCTION--With the arrival of atomic energy as an important factor in national defense, armed forces personnel are called upon to take part in the handling, measurement, and detection of radioactive materials. The following paragraphs will acquaint such personnel with the nature of atomic radiations, the necessity for detecting them, and methods of detection.

b. ATOMIC RADIATION--Many chemical elements, such as radium and uranium, and materials exposed to powerful radio-active disintegrations have the property of expelling radiations or rays which are invisible to the eye. Some of these radiations can penetrate the human body and, if they are of sufficient intensity or duration, can cause serious injury and death. To prevent exposure to damaging concentrations of radioactive materials and to prevent exposure to damaging radiation fields, equipment is provided which detects the presence of these radiations and measures their intensity.

Emissions by radioactive substances are generally composed of alpha, beta, and gamma radiations. Certain characteristics of these radiations are important aids in their detection and measurement. The alpha has a positive charge; it ionizes gases strongly, but it has weak penetrating power. The beta has a negative charge; it does not ionize gases as readily as the alpha, but its penetrating power is much greater. The gamma has no charge; it ionizes gas molecules by reaction with them, and its penetrating power is stronger than that of the alpha and beta radiations.

c. DETECTION OF RADIATION--The ability of alpha, beta, and gamma radiations to ionize gases is the characteristic most frequently used to detect the presence of radiation. A simple device for such detection is the G-M tube (figure 2-1). The tube is filled with a gas mixture at

low pressure. A thin wire, the anode of the tube, is oriented axially to a cylinder and insulated from it. A voltage is impressed across the tube so that the wire is positive with respect to the cylinder. The magnitude of the impressed voltage is just below that necessary to ionize the gas molecules and cause conduction. Therefore, in the dormant condition, no current flows. When radiation is present in the vicinity of the tube, an incoming radiation usually ionizes some molecules of the gas within the tube. The ionized gas particles are attracted toward either the cylinder or the wire, depending on their charge. On their way through the gas, these ionized gas particles collide with non-ionized gas molecules and ionize them. As a result of this action, a large portion of the gas becomes ionized, this producing a large current flow. This current flow is quenched quickly, either by a small amount of organic vapor which is included in the gas mixture or by the use of external circuits which reduce the potential between the tube elements after conduction. As soon as tube conduction stops, the voltage across the tube is returned to the original preignition value, and the tube awaits the next ionizing event. The duration of tube conduction is short compared to the average time between ionizing events and, therefore, the tube output is in the form of a series of pulses. Because of the fluctuating intensity of the ionizing radiations, the random time interval between ionizing events, and the chance arrangement of the gas molecules in the G-M tube, the pulses produced by the tube vary in amplitude (1/2-volt to 50 volts) and duration (50 to 100 microseconds), and occur at random time intervals. These pulses are generally used to activate various indicating devices.

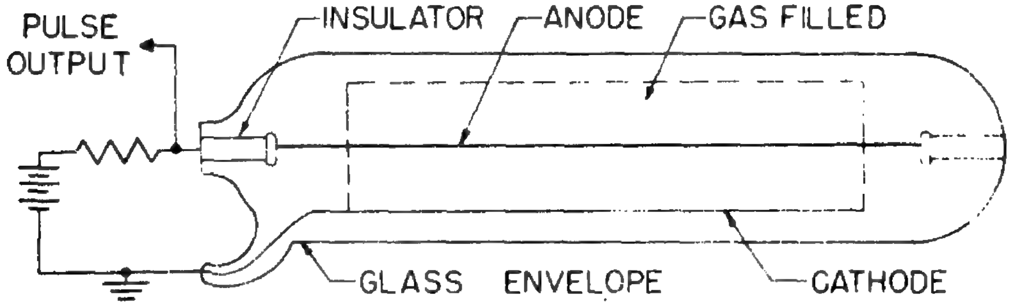


Figure 2-1. Typical Geiger - Muller Tube

d. MEASUREMENT OF RADIATION--The unit of measurement of radiation is called the "roentgen", or "r", and is defined as the amount of gamma radiation that will produce one electrostatic unit of charge in one cubic centimeter of air that is surrounded by an infinite mass of air at standard conditions.

Radiation values are usually expressed as milliroentgens per hour, (one thousandths of an "r") or mr/hr. Human tolerance to radiation is usually defined in terms of these units. Radiation intensity (in mr/hr) decreases rapidly as the distance from the radioactive object is increased.

2. GENERAL CIRCUIT DESCRIPTION. (See figure 2-2.)
--Dry batteries supply + 135-volt d-c power to the high-voltage power supply and the shunt voltage regulator circuits, 1.5-volt d-c filament power to the high-voltage power supply, the shunt voltage regulator, and the pulse shaper and amplifier circuits, and a 22.5-volt d-c bias voltage to the shunt voltage regulator circuit. The batteries are the source of all power for the equipment and, at 250 C. (77° F.), can power it for approximately 40 hours of continuous operation.

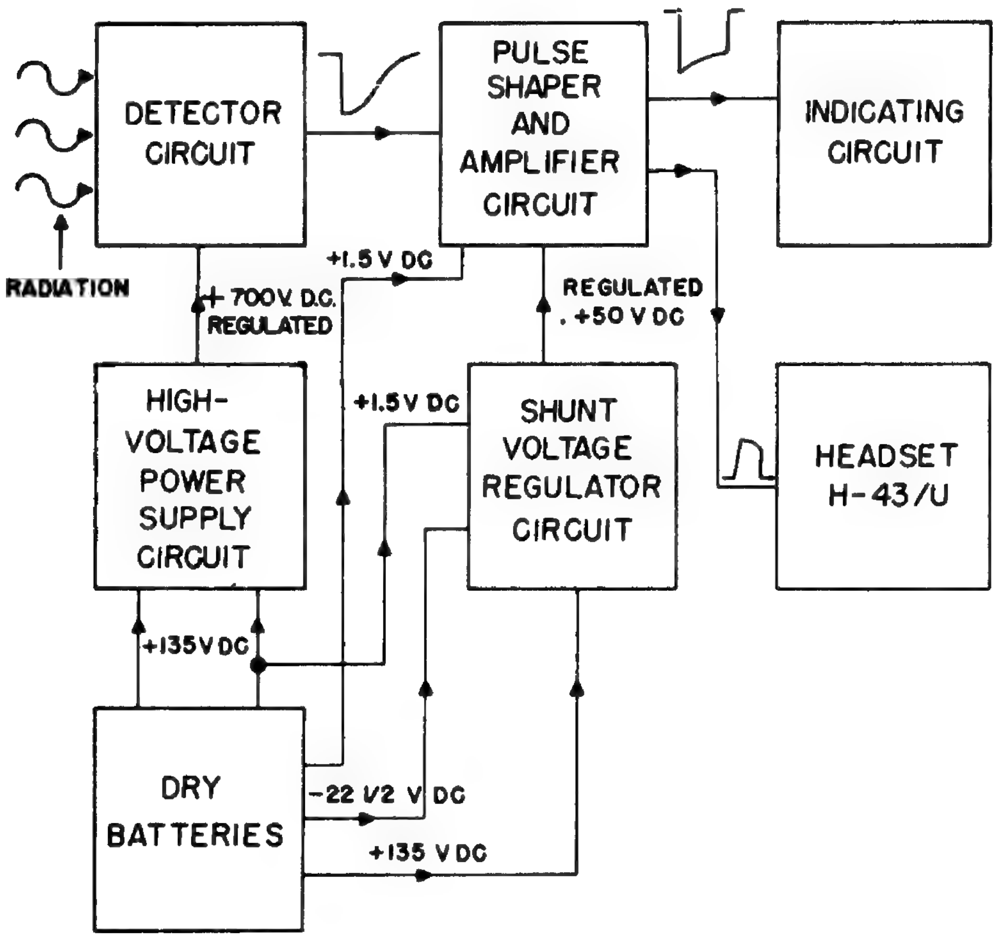


Figure 2-2. Radiac Set AN/PDR-27A, Block Diagram

The high-voltage power supply circuit converts the +135-volt d-c power from the batteries into regulated

Step 4. Remove the radioactive test sample from the carrying case.

step 5. Turn the range switch to 500. Hold the test sample under the radiacmeter housing as shown in figure 3-3A. Move the test sample to and fro to obtain maximum meter deflection. The meter reading should be 15 to 30 mr/hr.

Step 6. Turn the range switch to 50. Hold the test sample under the radiacmeter housing as shown in figure 3-3A. Move the test sample to and fro to obtain maximum meter deflection. The meter reading should be 12 to 22 mr/hr.

Step 7. Turn the range switch to 5. Hold the active end of the test sample near the radiacmeter probe as shown in figure 3-3B. The meter readings should be 1.5 to 2.5 mr/hr.

Step 8. Turn the range switch to .5. Hold the test sample near the radiacmeter probe, as shown in figure 3-3B, with the active end of the sample pointing away from the probe. The meter reading should be 0.18 to 0.30 mr/hr.

Step 9. Replace the test sample in the carrying case.

Step 10. If the meter readings specified in steps 2, 3, 5, 6, 7, and 8 are obtained, the radiac set is in proper operating condition. If any of the meter readings are incorrect, trouble shoot the radiac set as instructed in Section 7.

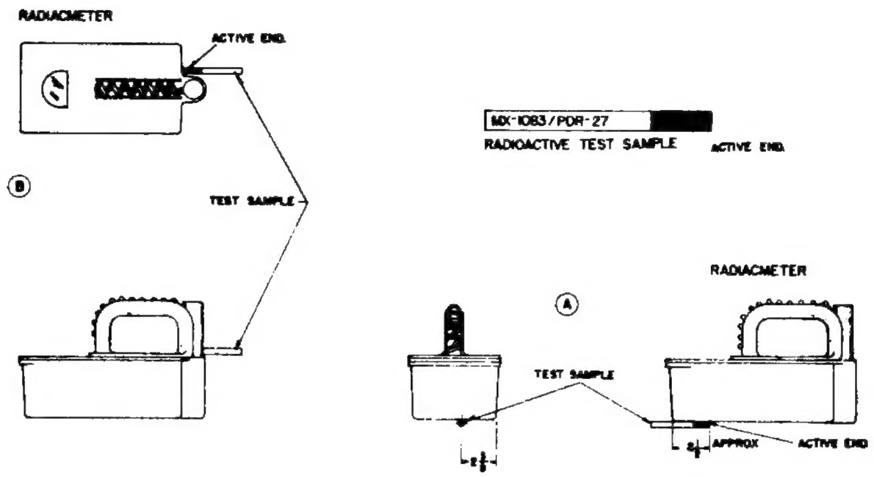


Fig. 3-3 Radiacmeter Test Set-up

Fig. 3-4 Survey Meter AN/PDR-27A showing attachment with shoulder harness.

b. CALIBRATION PROCEDURE

WARNING

Calibration of this equipment necessitates the use of a radium source. Exercise due caution in the handling of the source. Obey all radiation safety precautions. Perform the calibration as rapidly as possible to avoid prolonged exposure to the radiation.

Step 1. Loosen the six screws securing the radiacmeter panel to the housing. Remove the housing and replace it with the special housing. Check the battery condition. Check to see that the beta shield covers the end of the radiac detector, then slip the detector into the well of the radiacmeter.

Step 2. Arranged the equipment as indicated in figure 7-5. Measure and adjust each distance carefully, then observe the radiacmeter indication; if it differs by more than lM from the specified value, adjust the proper calibration potentiometer until the correct value is indicated on the meter. If the weight of the radium source is not two milligrams, or if it is desired to calibrate the radiacmeter at intensities not shown in figure 7-5, use the following formula to find the relation between meter indication and distance between radiacmeter and radium source:

$$\mathrm{mr/hr} = \frac{1333 \times W}{D^2}$$

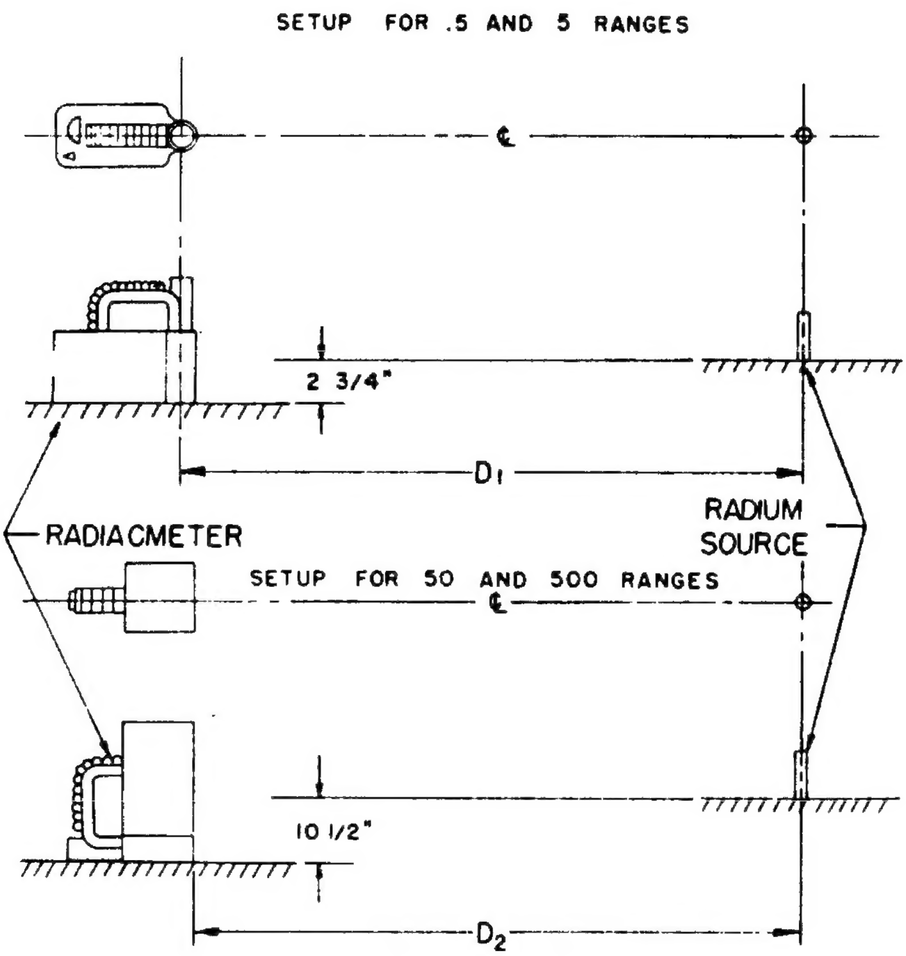
where

mr/hr = radiation intensity in milliroentgens per hour.

W = weight of radium source in milligrams.

D = distance between radiacmeter and radium source in inches.

Step 3. After all four ranges have been adjusted, turn the range switch to OFF. Then remove the special housing from the radiacmeter. Stake the four calibration potentiometers by applying electrical insulating varnish Navy specification 52-V-13 Grade CA (SNSN 52-V-1240 for a 1 pint can, 52-V-1255 for a one gallon can) with a small brush such as SNSN 38-B-2005.



CHECK	RANGE	D_1 INCHES (± 1/4)	D_2 INCHES	ADJUST	TO READ MR/HR
1	.5	81.6	———	R-110	.40
2	5	25.8	———	R-104	4.0
3	50	———	7.72	R-106	40
4	500	———	2.14	R-108	400

NOTE: ABOVE VALUES APPLY ONLY TO CALIBRATION BY 2-MILLIGRAM RADIUM SOURCE.

Fig. 7-5 Calibration Set Up Data